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THE HISTORIAN AND THE HISTORY OF SCIENCE[1]

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1. THE HISTORY OF SCIENCE AND THE INTERPRETATION OF HISTORY

THE history of science has been a subject of much discussion and a field for considerable productive activity, but most of such discussion and activity has been carried on by natural scientists. It is a subject, however, which ought to attract much interest from historians of liberal tendencies, and this article will attempt in a very brief way to estimate the significance of the history of science for historiography, to summarize the progress thus far made in the subject in this country, and to introduce a few generalizations concerning the desirable method of presenting it through the cooperation of historians and scientists.

The view of the significance of the history of science as a branch of historiography must necessarily vary with the attitude taken with respect to the nature of history.[2] If one adheres to the standpoint of Vico, Hegel, Kidd and the religionists, or to that of Thierry, Lamartine, Carlyle and the Romanticists, with their eulogy of heroic biography and their definite trend toward obscurantism, then there can, indeed, be little or no sympathy expected with the history of science. Nor can much more interest or approval be hoped for those who, with Seeley or Freeman, hold that history is the "biography of states" or "past politics," unless perhaps they might grudgingly admit that the invention of gunpowder or the steamboat has had significant results for the growth of national states and world empires, or that the scientific achievements lying back of the art of making modern artillery or steel armor for dreadnoughts may have slightly influenced the course of modern armed conflicts or greatly complicated the problems of national budgets. In fact, little sympathy or interest can be expected from the "eminent" and "respectable" historians as a group. No doubt President Thayer has already classified this conference as one of the most obvious "recent fallacies of historians."[3] The only type of historian who is likely to give serious and sympathetic attention to the history of science is the member of that renegade and outlaw, but ever increasing group which has transcended archaic and illogical conventions and dared to view history as a record of human achievement conceived in its broadest sense as the progressive establishment of human control over nature and the increasingly more perfect adaptation of nature to human use.[4] In this process science, pure and applied, has unquestionably been the dominating factor.[5]

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[1] Revision of a paper read at the Conference on the History of Science at the American Historical Association Meeting, Cleveland, Ohio, December 31, 1919. The Conference was presided over by Professor George L. Burr, and papers were read by Professors T. Wingate Todd of Western Reserve University, Louis C. Karpinski of the University of Michigan, Lynn Thorndike of Western Reserve University, and Henry Crew of Northwestern University. It was the first general session of the American Historical Association ever devoted entirely to the history of science.

[2] The writer has attempted to summarize some of the various interpretations of history in his article on "History: Its Rise and Development," in the new edition of the *Encyclopedia Americana*. See also the article on "The Interpretation of History," by James T. Shotwell in the *American Historical Review*, July, 1913, pp. 692 ff.

[3] *Cf.* the presidential address of William Roscoe Thayer to the American Historical Association at Cleveland, December 29, 1919, on "Recent Fallacies in History," *American Historical Review*, January, 1920. See also his article on "Vagaries of Historians," in the *American Historical Review*, January, 1919, especially pp. 186 ff.

This position can best be substantiated by adopting at the outset the more recent anthropological theories regarding the origins of science. Our concepts in this respect were for years perverted by the vicious generalization of Frazer to the effect that all of primitive science was to be found wholly in the realm of the occult, or, more specifically, in magical activities.[6] There has been no more significant revision of our anthropological background of cultural origins than that which has been forced through the critical work of Boas and his disciples, Marett and others, which has finally demonstrated the generic relation of religion and magic and has revealed the origins of science as proceeding primarily from the discoveries growing out of the everyday secular and commonplace activities of primitive peoples, however much such discoveries may later give a certain religious sanctity to their makers.[7] To be sure, this view does not deny the all-pervading religious *milieu* of primitive life in all its phases, but assumes that magic, as a phase of primitive religion, has evident associations with primitive science and economic life. Nor do the more critical anthropologists claim to be able to clear up from a study of primitive peoples all the problems connected with the position of magic and science in the Middle Ages—a period which is a great historic complex of primitive survivals and advanced cultural states and products. The critical anthropologist admits freely that the medieval period is one preeminently for the historian to deal with, but insists that the historian should start right with an up-to-date and scientific anthropological outlook.[8]

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[4] See the introductory paragraphs to the article on "History" by James T. Shotwell in the eleventh edition of the *Encyclopedia Americana*. See also James Harvey Robinson, "The New History," Chapter V.

[5] There is a brilliant passage on this point in Gabriel Tarde's "Les Transformations du Pouvoir," pp. 188–190.

[6] J. G. Frazer, "The Golden Bough," Vol. I., pp. 220–243.

When the origins of science are viewed in this more accurate manner the history of science has a peculiar significance for the general interpretation of historical development. The vital and probably causal dependence of political forms and processes upon economic factors and institutions has now been so well established as to make a reminder of the situation seem almost an antiquated platitude.[9] It has been less frequently and less clearly pointed out, however, that the progress of science has in turn given shape and direction to economic development from the very beginnings of cultural history. There have been those who have questioned this generalization and who have asserted that pure science has had no genetic connection with applied science and industrial inventions. They have based their position on the alleged derivation of science from primitive magic, which certainly did not direct and dominate, however much it may have been associated with, primitive industry, and on the assumption that the inventions which initiated the Industrial Revolution, the greatest economic transformation in human history, bore little sequential relation to previous advances in pure science. It has already been shown how inaccurate is the assumption of the identity between primitive science and magic. The case of the Industrial Revolution, when critically examined, is not less damaging to the views of this group. Watt's perfection of the steam engine was based upon studies of atmospheric pressure by Torricelli and Von Guericke, Huyghen's experiments with the gun-powder engine, Boyle's study of gases and pneumatics, and upon the developments following the experiments of Denys Papin, the Marburg physicist, as well as the contemporary work of Joseph Black on latent heat. A great part of the engineering achievements which have made possible modern industrialism and the indispensable means of transportation have been founded upon the development of mechanics from Galileo and Newton onward. Even the stock objection to the scientific interpretation which centers about the textile inventions from Kay to Cartwright are not as impregnable as earlier supposed. For example, the spindles and belt wheel of the spinning-wheel from which Hargreaves developed his "spinning jenny," as well as the waterwheel which early propelled these machines, were a combination of several epoch-making inventions of primitive scientists. Moreover, from the late eighteenth century to the present time industrial progress has become more and more closely associated with highly scientific technological advances, such as modern industrial chemistry and the remarkable development of modern mechanical and industrial engineering. While there can, thus, be little doubt that even in the past pure and applied science has determined economic institutions, it is certain that this relation will become much more intimate in the future—which, as Professor Thornstein Veblen has insisted, is to be preeminently the technological age in which not only competitive individual economic success but also the "wealth of nations" will depend no longer purely upon superior commercial sagacity, but upon even very slight and extremely refined technological superiority. If, then, we may accept the priority of scientific to economic processes, those who adhere to the views of Bacon, Condorcet, Buckle, Draper and Andrew D. White have advanced one step beyond Feurbach and Marx in the interpretation of history. Finally, to the importance of the history of science in explaining the development of the most potent instrument by which man has progressed through the adaptation of nature to his use, there should be added the unusual disciplinary virtue of the history of science, combining as it does the genetic concepts of history with the exactness and the severe accuracy of the methodology and procedure of the natural sciences.

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[7] An excellent critical review of the leading anthropological theories concerning religion and magic is given by Dr. A. A. Goldenweiser in an article on "Magic and Religion" in the *Psychological Bulletin*, March, 1919, pp. 82 ff.

[8] This subject has been surveyed by Dr. Lynn Thorndike in his "The Place of Magic in the Intellectual History of Europe." Professor Thorndike is now engaged upon an exhaustive treatment of the field of medieval science and magic.

[9] The literature on the subject is admirably analyzed by Professor E. R. A. Seligman in his "Economic Interpretation of History." The works of Professors F. J. Turner and C. A. Beard have been the most stimulating American application of the doctrine.

Again, the study of the history of science from the point of view of historical interpretation adds one more reason for believing in its fundamental significance, namely, its relation to intellectual history and the psychological interpretation of history in general, a field opened by Draper and which has since been cultivated by a number of progressive historians led by Professor James Harvey Robinson.[10] It has generally been recognized that the history of science forms a most vital phase of intellectual history, but this conception is still further strengthened by the newer view, so effectively expounded by Professor Veblen, especially in his "Instinct of Workmanship," and his "Place of Science in Modern Civilization," concerning the intimate connection which exists between the various stages of intellectual development and the changing state of the industrial arts, which are, in turn, dependent upon scientific advances. It would seem, then, that the history of science provides the most fundamental and illuminating background for the study of the history of civilization, compared with which the history of states and political intrigues dwindles to insignificant proportions. It may be, and indeed often is, objected that while science may have created modern civilization, in doing so it brought into being a Frankenstein monster which is rapidly getting out of human control and whose ravages science can do nothing to mitigate. The historian would be the last to deny the serious social and economic problems produced by modern industrialism, but he will probably insist that science alone can point the way out. In support of this view might be cited the achievements of sanitary and medical science, not only in the field of physical disease, but also in its application to social problems and industrial efficiency, and to the apparent progress now being made in the direction of at last securing a rational system of ethics based on sound psychology. This view that science and technology must be the chief agencies that man can make use of in solving the problems of modern industrial society was forcibly stated by the founder of modern *Kulturgeschichte,* Karl Lamprecht, in his address to the general meeting of the Association of German Engineers at Leipzig in 1913 on "The Technics and Culture of the Present Day." After pointing out the general relation between the development of culture and technology he expressed his belief that "it is in the development of technics and modern industry themselves that we must look for an expedient for removing the moral and social evils which have been called forth through a brilliant material progress. No superficial suppression of these evils, no administration of charity, no theories, no political revolution can have any lasting effect in attaining this end, but only the moral self-purification of industrial development in itself, and that change to idealism, which must be accomplished in and from the further development particularly of technics."

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[10] The writer has attempted to indicate the progress made in this field in an article on "Psychology and History," published in the *American Journal of Psychology,* October, 1919.

2. General Neglect of the History of Science by Historians

Aside from a feeling of gratitude and satisfaction over being able to have at one of our Association conferences such a group of eminent scientists, the fact which strikes a historian most vividly with respect to this conference is that at the first session of the American Historical Association on the history of science, three out of four of the formal papers were presented by natural scientists. The situation is all the more significant because this disparity was not due to any determination to go outside the ranks of historians for speakers, but rather was caused by the somewhat embarrassing fact that it reflects very accurately the distribution of the current activity in the history of science, for probably more than seventy-five per cent. of such interest is found among natural scientists. This state of affairs seems particularly strange in view of the fact that there have long been historians and other social scientists who have emphasized the dominating part played by science in the evolution of civilization. Roger Bacon's striking prophecy of the effect of applied science is too well known to describe in detail. Away back in the latter part of the fourteenth century Ibn Khaldun, an Arab savant, definitely rationalized and isolated the history of civilization and emphasized the part played by Arab natural science in the development of civilization. Francis Bacon stressed the importance of intellectual history and had great hopes that general advancement and betterment might be achieved through the application of natural science. Turgot, in his Sorbonne lecture of 1750, showed how progress was dependent upon the cumulative social, economic and scientific advances contributed by each generation and stressed in that way the continuity of history. Condorcet set forth what, at the close of the eighteenth century, looked like an extremely fantastic, but in the light of the last century a rather conservative, estimate of the general progress that might be expected from the application of natural science to human activities.

Henri de Saint-Simon and his disciples, drawn largely from students at the *Ecole Polytechnique,* not only agreed in general with Condorcet, but also advanced a step further by comprehending the vital importance of applied science and in advocating the formation of a social system controlled and directed in its material interests by scientists and engineers. Auguste Comte sketched a philosophy of history in which progress was held to consist in the gradual but sure triumph of the scientific method and procedure over the theological and metaphysical, planned a social system dominated by applied scientists and sociologists and attempted to secure the establishment of a chair in the history of science at the Collège de France. That interesting mid-century socialist, Wilhelm Weitling, would have handed over the complete control of society to a triumvirate made up of the most eminent living physician, mechanical engineer and physicist. Space forbids more than a mere mention of the well-known favorable attitude towards science and its history taken by Buckle, Draper, Andrew D. White, Henry Adams, Thornstein Veblen and Lester F. Ward. Among more recent historians there are a number who have emphasized the significance of science in the evolution of civilization. Some leaders in this movement have been Lamprecht and his associates, Seignobos, F. S. Marvin, and Professors Burr, Robinson, Shotwell, Shepherd, and Teggart in this country. There have been technical historians of science varying all the way from the ecstatic Karl Snyder to the encyclopedic Duhem and the erudite and cautious, if enthusiastic, Sarton, who have urged the importance of science and the significance of its history. The work of Mach, Cantor, Ostwald and Danneman in Germany; of Mieli and Rignano in Italy; of Duhem, Berthelot, Milhaud, Tannery, Picard and Poincaré in France; of Sarton in Belgium; of Merz, Pearson, Shipley, Lones, Singer, Osler, Ross, Thomson and Tozer in England; and of Sedgwick, Tyler, Cajori, Locy, Crew, Karpinski, Henderson, Baldwin, Libby, Hall and Garrison in this country is at least representative of the valuable contributions made to the field of the history of science by natural scientists. In spite of all this, however, one can point to but few European historians, taking the title in its conventional meaning, who have devoted themselves professionally to the history of science, and it seems that Professor Lynn Thorndike is the only one in this country who has cultivated the subject systematically, though one should not forget the valuable monograph of Miss Ornstein on the rise of the European scientific societies. The lure of the episodical, the dramatic, the biographical and the political history, produced by the inertia in the heritage from older historical interests and concepts and the development of nationalism in the 19th century, has proved too strong for the majority of historians and has seduced them into a grotesque concern with the irrelevant and into a sad ignoring of the vital elements in historical development. It has not been sufficiently emphasized that there are two chief types of superficiality and inaccuracy in history, the first being that which leads to statements made without a sufficiently thorough and dispassionate study of the sources of information, and the second and equally serious variety being that which leads to a failure to concentrate historical investigation upon those topics which seem likely to reveal most clearly the nature and causes of human progress.[11] It is a strange but interesting fact that those who have been most cautious in avoiding the first type of superficiality have been most frequently and fatally guilty of the latter.[12] It would seem that the chief cause of this has been the unfortunate tendency to make states, political institutions and political figures the chief center of orientation and point of departure for historical study and exposition. This has led to a situation in history not widely different from the procedure of a hydraulic engineer who studied the ice on a river and ignored the depth and rapidity of the current, or a geologist sent to make a detailed study of the soil and minerals of a particular area and who satisfied himself with a report on some conspicuous phases of the topography, or who studied a glacier by noting the débris which had accumulated on its surface and ignored the vast mass of ice moving irresistibly beneath.

One is especially reminded of the significance of the history of science, as well as of its relative neglect, when he reflects upon the vast amount of scholastic energy spent upon that chronological succession of guesses as to the nature of reality which is collectively known as the history of philosophy, and also upon the history of the various methods and avenues in which man has gone wrong in attempting to get control over nature and to adapt it to his use, in particular, the vast number of pretentious volumes devoted to the history of religion, the chief mechanism for hoping to attain a supernatural control over the forces of nature—the contrast of which with the scientific approach has been most effectively drawn by the late Andrew Dickson White.[13]

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[11] See James Harvey Robinson, "The New History," Chapters I., IV., V., VIII.; and Albion W. Small, *Publications of the American Economic Association,* Third Series, Vol. V., No. 2, p. 178.

[12] See Karl Lamprecht, "What is History?" Chapter I.

3. PRESENT STATUS OF THE HISTORY OF SCIENCE IN AMERICAN EDUCATION

The status of the teaching of the history of science in the United States before university instruction was so seriously disrupted by the War has been described in a valuable study made by Mr. Frederick E. Brasch in a paper entitled "The Teaching of the History of Science: Its Status in our Universities, Colleges and Technical Schools," and published in *Science* for November 26, 1915.[14] He studied 352 out of 598 institutions of this type which existed in the country at that time and found that 224 had some course on the history of science and that 128 had none. The first course on the history of science in America appears to have been one on the history of chemistry given by Dr. Theodore W. Richard at Harvard University for the first time in 1890. At practically the same time[15] Professors Sedgwick and Cross at the Massachusetts Institute of Technology began a course on the history of the biological and physical sciences which has been carried on since 1905 by Professors Sedgwick and Tyler. This was the first course in the general history of science given in this country. Perhaps the best known course on the general history of science now offered is that which had been conducted at Harvard, since 1911, by Professor L. J. Henderson. Mr. Brasch found that in 1915 there were many more courses offered on the history of special sciences than on the general history of science, the emphasis being particularly upon the mathematical and physical sciences at the expense of the biological, but he believed that he detected a tendency on the part of these institutions of higher learning to abandon the history of special sciences and to go over to a general course. Most of the larger universities were found to offer both general and special courses in the history of science and an unusual interest in the subject was manifest at the Carnegie Institute of Technology at Pittsburgh. A gratifying innovation of a missionary sort was to be seen in the work of Professor Henderson of Harvard who gave a series of lectures on the history of science to some five middle Western colleges in the spring of 1915. Finally, excellent facilities for detailed investigation in the history of science have been provided for in the John Crerar Library at Chicago, the resources of which were, in part, made public in a bibliography prepared by Dr. Josephson in 1911 and brought up nearer to date in a supplement of 1916. Nor should one forget the promising periodical devoted to the history of science—*Isis*—edited by Georg Sarton, the publication of which was, unfortunately, disrupted by the war, or the various publications edited by Professor Cattell, which have encompassed practically the whole field of science.

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[13] Of course this statement does not imply any reflection upon the very valuable contribution to intellectual and cultural history made by students of the history of philosophy and religion, but simply attempts to make more clear the relative neglect of the history of science.

[14] *Loc. cit.*, pp. 746–60.

[15] Professor Sedgwick began his lectures in an extra-academic way as early as 1887.

While Mr. Brasch's study thus revealed significant beginnings in the history of science in the United States it gave no evidence of any interest in the subject on the part of the historical guild. It is doubtful, indeed, if at that time there was any special course on the history of science offered by historians. Probably the closest approximation was the courses in intellectual history, the history of civilization, and the expansion of European civilization given by Professors Robinson, Shotwell and Shepherd at Columbia, the composite course on the history of civilization offered at Cornell, and certain advanced senior work on medieval education and intellectual interests given by Professor Haskins at Harvard, with some very significant literary activity in the subject on the part of Professor Thorndike at Western Reserve University and Professor Teggart at California. This state of affairs suggests the question as to whether matters should remain ever thus, with the historians generally ignoring the subject, and brings one to the final point in this discussion, namely, a consideration of the type of cooperation and division of labor between natural scientists and historians which is desirable in teaching and writing in the field of the history of science.

4. THE NECESSITY OF COOPERATION BETWEEN HISTORIANS AND SCIENTISTS IN THE FIELD OF THE HISTORY OF SCIENCE

It would seem that the manner of teaching the history of science should be determined sharply by the object which it is desired to obtain. It is obvious that there are four chief results to be aimed at, each of which calls for a special course; first, a technical knowledge of the history of a certain special natural science designed to aid experts in arriving at a better command of their particular subject; second, a more general grasp of the development of all the natural sciences which will make clear the manner in which the progress of the several natural sciences has been interrelated and cumulative; third, an analysis of the history of method which will illustrate the nature and unique character of the methodology of the natural sciences and the manner in which this methodology and technique has evolved; and, fourth, an introduction to the history of intellectual interests and cultural progress which will indicate the part played by science in the history of civilization and will reveal scientific progress in its proper perspective in the general evolution of intellectual interests. It would appear certain that the first three types of courses should normally be taught by natural scientists and the last by historians, though occasionally an alert student of philosophy will be found admirably qualified to give the courses on the general history of science and the evolution of the scientific method. But in both the courses on the history of science and on the history of intellectual interests there should be frank and sympathetic cooperation between scientists and historians. This cooperation, unfortunately, has not generally existed in the past. The scientist, at least in this country, has generally despised the historian when the latter has upon very rare occasions entered the boundaries of natural science and the historian has generally escaped this contempt by ignoring the history of science altogether. This mutual lack of respect and interest and the resulting failure to cooperate has led to a serious loss to both scientists and historians. Scientists, particularly in this country, have exhibited an extremely naïve and uncritical attitude in the matter of handling the historical sources dealing with their subject, works of all varieties of age, accuracy and bias often being used in an indiscriminate manner provided they furnish direct statements of alleged fact, and often some of the most valuable sources of information have been ignored altogether. There also has frequently been displayed a painful lack of power in orderly and attractive narration, which would scarcely be found even in a doctoral dissertation in history.[16] The admitted critical and literary superiority of European historians of science to the American may in part be due to the closer cooperation between them and their colleagues in the faculties of letters and in the field of history. Further, the natural scientist has often seemed to assume that the progress of science has been solely a result of individual investigation, experimentation and discovery, while as a matter of fact the historian well knows that it has been quite as much the product

[16] For a candid recognition of these defects in works on the history of science written by natural scientists, one should consult the article on "The History of Science" by Dr. Louis C. Karpinski in *School and Society*, December 21, 1918. This is written by a natural scientist well grounded in historical methodology.

of circumstances in the general historical environment which have encouraged and made possible scientific endeavor and achievement. In other words, while the progressive historian will freely admit that science has done much to determine the course of historical events he must insist that culture has been quite as effective in conditioning the nature and rate of progress in the natural sciences.

From the historical viewpoint the rather austere scorn of the natural scientist for the historian has sometimes led the latter to risk some excursion in the field of science without having checked up his work by consultation with a scientific expert, but more often it has simply been effective in keeping the historian out of the field, and incidentally in preventing college students of history from having an adequate opportunity to become acquainted with what should constitute, perhaps, the most vital phase of history. Of course it is not meant that historians have always recognized the significance of the history of science and have clamored in crowds for permission to enter the field, being deterred only by the lack of encouragement from scientists. The general body of historians have certainly been as naïve in ignoring science as have scientists in sifting historical sources. What is asserted is that the few historians who have shown an interest in the history of science have not generally met with a warmly sympathetic welcome from scientists. The scientists should recognize that until the history of science is espoused by a large number of historians it can not have its deserved recognition in the academic world and they should cherish, encourage and enlighten the few historians who evince an interest in science with as great care and enthusiasm as a biologist would nurse along the rarest and most interesting sport or mutation which might appear in the evolution of organic life. The growth of mutual respect and the stimulation of cooperation between historians and scientists cannot but be productive of the greatest gain to both. The scientists can receive aid in sifting their sources and arranging their material, while the historians can secure sure and accurate guidance in the technical phase of the subject. It can scarcely be doubted, moreover, that the unquestionably greater objectivity, frankness and candor, and the more earnest search for truth and vital information which characterizes natural scientists, as contrasted with historians and social scientists generally, will have a salutary reaction upon historians. Further than a mere cooperation in research and exposition, historians and scientists should arrange for a better guidance of their students. Certainly no major student in science should regard his scientific training as well rounded out without comprehending the relation of the history of science to general cultural evolution and the history of intellectual interests and no student of history can be held to be competent in his subject without a decent elementary grasp upon the history of science, for which he may be prepared, if otherwise deficient, by a preliminary course in general science, which should always include some personal contact with and observation of, the exact and painstaking methods of the scientist in laboratory work. It may also be safely asserted that students of science who hope later to teach its history or to write on the subject should during their college course take a thorough course in historical methodology, both in investigation and exposition.

The progress made by natural scientists in teaching and writing in the field of the history of science has already been pointed out and this morning's conference will be welcomed by historians as a harbinger of their closer cooperation with alert students of the newer history. From the historian's side, also, certain significant advances have already been made in this country which to some degree supplants the blank indicated in Mr. Brasch's report on the history of science. Professor James Harvey Robinson in his well-known course on the history of the intellectual classes of Europe has provided, especially in his latest syllabus, an excellent prospectus for a synthesis of the history of science and general intellectual interests, and his point of view has affected many of the younger teachers of history and is evident in the text-books of Breasted, Thorndike, Hayes and Schapiro. Professor Shotwell's famous course on the evolution of European civilization centers largely around the progress of pure and applied science and its reaction upon civilization, particularly its effect upon economic life and activities. It is doubtful if any other American historian, with the possible exception of Professor Robinson, has done as much to direct the attention of the historian to the significance of the growth of science in determining the progress of civilization as Professor Shotwell. Professor William R. Shepherd, in his original course on the expansion of European civilization, has for the first time made clear how far the development of European science in modern times has been due to the reaction of world colonization, exploration and commerce upon European thought.[17] The salutary influence of Professor Burr's teaching and writing in stimulating interest in intellectual history has long been recognized and has permeated the text-book of Professor Hulme on the Renaissance and Reformation, as well as having led to the production of many scholarly monographs in the field of intellectual history. While Professor Haskins has not been usually regarded as a special protagonist of intellectual history no one in Europe or America has done work of a more scholarly nature in this field, and of late he has offered a general course on medieval intellectual history. Further, historians in this country and abroad have at last supplied works that make possible a fairly complete survey of intellectual history. The writing of Breasted, Rogers and Jastrow on the Oriental period; of Zeller, Gomperz, Murray, Zimmern, Fowler, Wissowa and Cumont on the classical era; of Taylor, Poole, Lea, Harnack, Burr, Rashdall, Pactow, Thorndike, Workman and Lecky on the Medieval age; of Brandi, Voigt, Beard, Emerton and Hulme on the Renaissance and Reformation; of Shipley on the science of the seventeenth century; of Shepherd and Abbott on the expansion of Europe; of Fischer, Morley and Stephen on the thought of the eighteenth century; of Benn, Merz and others on the last century; and of Dewey, Royce, Santayana, Faguet, Pearson, Reinach and Dilthey on various topics in intellectual history are only certain conspicuous illustrations of the fertile work done in this field.

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[17] Professor Shepherd's original thesis in this matter is to be found summarized in his articles on "The Expansion of Europe" in the *Political Science Quarterly* for 1919.

There are courses in the history of civilization offered in American universities in which the development of science has been or may be introduced with profit to all concerned. A very significant innovation has been adopted this year at Columbia University whereby all freshmen are compelled to enter a course in contemporary civilization containing at least an introduction to the history of science, sufficient to indicate the scientific progress which lies back of modern civilization. It would seem, however, that, though a fruitful interest in the history of science may be aroused in this way, it is rather too early in the college course for the most effective presentation of the history of civilization. It is probable that the courses in the history of the special sciences should come in the junior year and should be followed in the last college year by the courses in the general history of science and in the history of thought and culture. There might also be mentioned the fact that a general course on the history of science is being offered for the first time this year at Clark College and Clark University under the direction of Dr. Edmund C. Sanford, president of the college, this being especially interesting as illustrating how such a course may be successfully handled by a student of philosophy and psychology, when possessed of sufficient erudition and a progressive viewpoint. But, important as these details may be, the vital preliminary step is for historians more generally to realize the significance of the history of science and for the scientists to descend to a plane of cooperation, and the details of the division of labor between the two fields and the pedagogical problems will be early and easily adjusted. While at present the scientists show much the greater activity in the history of science, the strength of the conventional in historical interests seem to be weakening and it is not absurd to predict that a generation hence such a book as Merz's "History of European Thought in the Nineteenth Century" will be regarded as containing more pertinent historical information than the "Cambridge Modern History" or James Ford Rhodes, "History of the United States since the Compromise of 1850."

Bibliographical Note.—There is no satisfactory treatment of the problem of the history of science and the method of presenting it for class-room instruction. Valuable suggestions may be obtained from the following easily accessible articles:

Mann, C. R. The History of Science. *Popular Science Monthly,* April 1908, pp. 313 ff.

Libby, Walter. The History of Science. *Science,* November 6, 1914, pp. 670–73. A Function of the History of Science, *Educational Review,* October, 1919, pp. 201–6.

Brasch, F. E. The Teaching of the History of Science. *Science,* November 26, 1915, pp. 746–60.

Sarton, G. The Teaching of the History of Science. SCIENTIFIC MONTHLY, September, 1918, pp. 193–211.

Karpinski, L. C. The History of Science. *School and Society,* December 21, 1918, pp. 741–49.

Sarton's article is especially valuable for its discussion of the requisite knowledge, equipment and pedagogical procedure in teaching the history of science, while Karpinski's is notable for its plea for a more critical method and more comprehensive research in gathering materials on the history of science.

The subject is discussed from the historian's point of view in Marvin, F. S., "Science and History," *Contemporary Review,* March, 1918; Robinson, J. H., "The Relation of History to the Newer Sciences of Man," *Journal of Philosophy, Psychology and Scientific Methods,* March 16, 1911; and Shotwell, J. T., "The Interpretation of History," *American Historical Review,* July, 1913. An excellent recent illustration of interrelationship between the history of science and the history of culture and intellectual interests is provided in the voluminous work of Edmund von Lippmann, "Entstehung und Ausbreitung der Alchemie," Berlin, 1919. See also J. H. Robinson's syllabus, "An Outline of the History of the Western European Mind," N. Y., 1919.